



STGD5NB120SZ-1 STGD5NB120SZ

N-CHANNEL 5A - 1200V DPAK/IPAK
INTERNALLY CLAMPED PowerMESH™ IGBT

Table 1: General Features

TYPE	V _{CES}	V _{CE(sat)}	I _C
STGD5NB120SZ	1200 V	< 2.0 V	5 A
STGD5NB120SZ-1	1200 V	< 2.0 V	5 A

- HIGH INPUT IMPEDANCE (VOLTAGE DRIVEN)
- LOW ON-VOLTAGE DROP (V_{cesat})
- HIGHT CURRENT CAPABILITY
- OFF LOSSES INCLUDE TAIL CURRENT
- HIGH VOLTAGE CLAMPING FEATURES

DESCRIPTION

Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix "S" identifies a family optimized achieve minimum on-voltage drop for low frequency applications (<1kHz). The built in collector-gate zener exhibits a very precise active clamping.

APPLICATIONS

- LIGHT DIMMER
- INRUSH CURRENT LIMITATION
- PRE-HEATING FOR ELECTRONIC LAMP BALLAST

Figure 1: Package

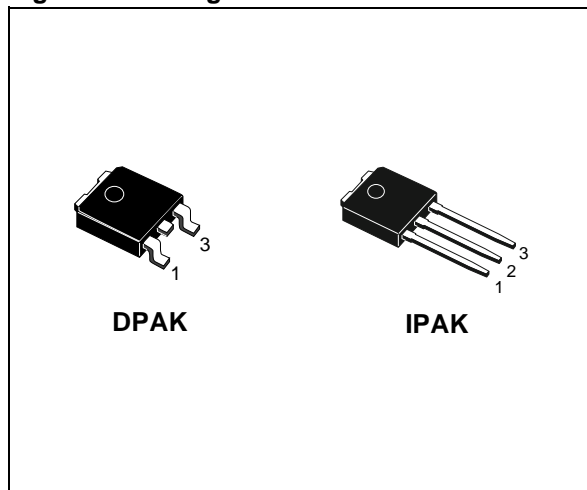


Figure 2: Internal Schematic Diagram

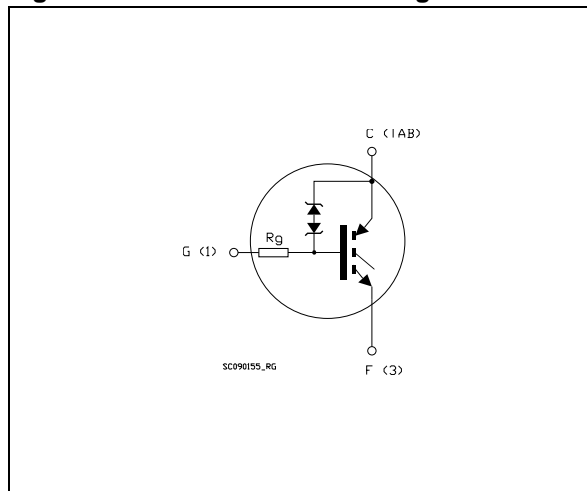


Table 2: Order Code

PART NUMBER	MARKING	PACKAGE	PACKAGING
STGD5NB120SZT4	GD5NB120SZ	DPAK	TAPE & REEL
STGD5NB120SZ-1	GD5NB120SZ	IPAK	TUBE

Table 3: Absolute Maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-Emitter Voltage ($V_{GS} = 0$)	1200	V
V_{ECR}	Emitter-Collector Voltage	20	V
V_{GE}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current (continuous) at $T_C = 25^\circ\text{C}$	10	A
I_C	Collector Current (continuous) at $T_C = 100^\circ\text{C}$	5	A
I_{CM} (■)	Collector Current (pulsed)	20	A
P_{TOT}	Total Dissipation at $T_C = 25^\circ\text{C}$	55	W
	Derating Factor	0.44	W/°C
Eas (1)	Single Pulse Avalanche Energy at $T_j = 25^\circ\text{C}$	10	mJ
	Single Pulse Avalanche Energy at $T_j = 100^\circ\text{C}$	7	mJ
T_{stg}	Storage Temperature	-55 to 150	°C
T_j	Operating Junction Temperature range	150	°C

(■) Pulse width limited by safe operating area

(1) $V_{CE} = 50\text{ V}$, $I_{AV} = 3.3\text{ A}$

Table 4: Thermal Data

		Min.	Typ.	Max.	
Rthj-case	Thermal Resistance Junction-case			2.27	°C/W
Rthj-amb	Thermal Resistance Junction-ambient			100	°C/W

ELECTRICAL CHARACTERISTICS ($T_{CASE} = 25^\circ\text{C}$ UNLESS OTHERWISE SPECIFIED)
Table 5: On/Off

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{BR(CES)}$	Collector-Emitter Breakdown Voltage	$I_C = 10\text{ mA}$, $V_{GE} = 0\text{ V}$	1200			V
I_{CES}	Collector cut-off Current ($V_{GE} = 0$)	$V_{CE} = 900\text{ V}$ $V_{CE} = 900\text{ V}$, $T_j = 125^\circ\text{C}$			50 250	μA μA
I_{GES}	Gate-Emitter Leakage Current ($V_{CE} = 0$)	$V_{GE} = \pm 20\text{ V}$, $V_{CE} = 0\text{ V}$			± 100	nA
$V_{GE(th)}$	Gate Threshold Voltage	$V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$	2		5	V
V_{GE}	Gate Emitter Voltage	$V_{CE} = 2.5\text{ V}$, $I_C = 2\text{ A}$, $T_j = 25 \div 125^\circ\text{C}$			6.5	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE} = 15\text{ V}$, $I_C = 5\text{ A}$ $V_{GE} = 15\text{ V}$, $I_C = 5\text{ A}$, $T_j = 125^\circ\text{C}$		1.3 1.2	2.0	V V

ELECTRICAL CHARACTERISTICS (CONTINUED)**Table 6: Dynamic**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs}	Forward Transconductance	$V_{CE} = 25\text{ V}$, $I_C = 5\text{ A}$		5		S
$C_{ies}^{(*)}$	Input Capacitance	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0\text{ V}$		430		pF
$C_{oes}^{(*)}$	Output Capacitance			40		pF
$C_{res}^{(*)}$	Reverse Transfer Capacitance			7		pF
R_g	Gate Resistance			4		K Ω

(1) Pulsed: Pulse duration= 300 μ s, duty cycle 1.5%**Table 7: Switching On**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Delay Time	$I_C = 5\text{ A}$, $V_{CC} = 960\text{ V}$ $V_{GE} = 15\text{ V}$, $R_{drive} = 1\text{ K}\Omega$ $T_j = 25^\circ\text{C}$		690		ns
t_r	Current Rise Time			170		ns
$(di/dt)_{on}$	Turn-on Current Slope			39.6		A/ μ s
$t_{d(on)}$	Dealy Time	$I_{CC} = 5\text{ A}$, $V_{CC} = 960\text{ V}$ $V_{GE} = 15\text{ V}$, $R_{drive} = 1\text{ K}\Omega$ $T_j = 125^\circ\text{C}$		600		ns
t_r	Current Rise Time			185		ns
$(di/dt)_{on}$	Turn-on Current Slope			39		A/ μ s

Table 8: Switching Off

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_c	Cross-over Time	$I_C = 5\text{ A}$, $V_{CC} = 960\text{ V}$ $V_{GE} = 15\text{ V}$, $R_{drive} = 1\text{ K}\Omega$ $T_j = 25^\circ\text{C}$		4		μ s
$t_r(V_{off})$	Off Voltage Rise Time			2.2		μ s
$t_{d(off)}$	Delay Time			12.1		μ s
t_f	Current Fall Time			1.13		μ s
t_c	Cross-over Time	$I_C = 5\text{ A}$, $V_{CC} = 960\text{ V}$ $V_{GE} = 15\text{ V}$, $R_{drive} = 1\text{ K}\Omega$ $T_j = 125^\circ\text{C}$		5		μ s
$t_r(V_{off})$	Off Voltage Rise Time			2.2		μ s
$t_{d(off)}$	Delay Time			12.1		μ s
t_f	Current Fall Time			2		μ s

Table 9: Switching Energy

Symbol	Parameter	Test Conditions	Min.	Typ.	Max	Unit
$E_{on(2)}$	Turn-on Switching Losses	$V_{CC} = 800\text{ V}$, $I_C = 3\text{ A}$ $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$, $T_j = 25^\circ\text{C}$ (see Figure 18)		2.59		mJ
$E_{off(3)}$	Turn-off Switching Loss			9		mJ
E_{ts}	Total Switching Loss			11.59		mJ
$E_{on(2)}$	Turn-on Switching Losses	$V_{CC} = 800\text{ V}$, $I_C = 3\text{ A}$ $R_G = 10\text{ }\Omega$, $V_{GE} = 15\text{ V}$, $T_j = 125^\circ\text{C}$ (see Figure 18)		2.64		mJ
$E_{off(3)}$	Turn-off Switching Loss			10.2		mJ
E_{ts}	Total Switching Loss			12.68		mJ

(2) E_{on} is the turn-on losses when a typical diode is used in the test circuit in figure 2.

(3) Turn-off losses include also the tail of the collector current.

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Table 10: Functional Test

Symbol	Parameter	Test Conditions	Min.	Typ.	Max	Unit
I _{as}	Unclamped inductive switching current	V _{CC} = 50 V, L = 1.8 mH T _{start} = 25°C, R _{drive} = 1 kΩ	3.3			A
I _{CL}	Latching Current	V _{CLAMP} = 960 V, T _j = 125°C R _{drive} = 1 kΩ		10		A

Figure 3: Output Characteristics

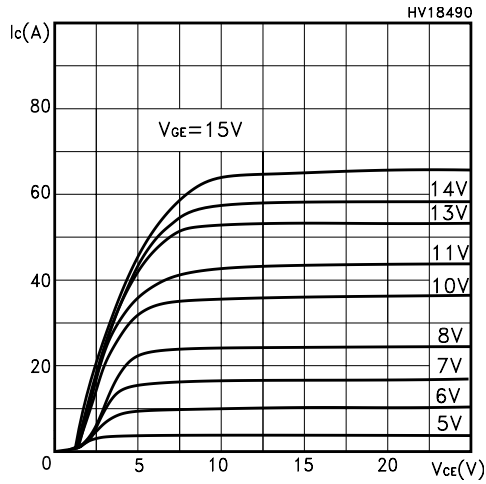


Figure 4: Transconductance

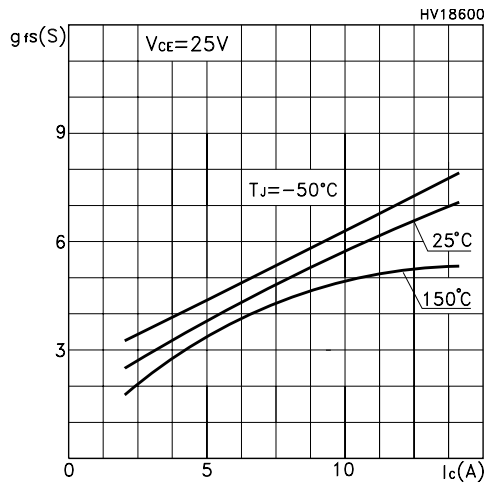


Figure 5: Collector-Emitter On Voltage vs Collector Current

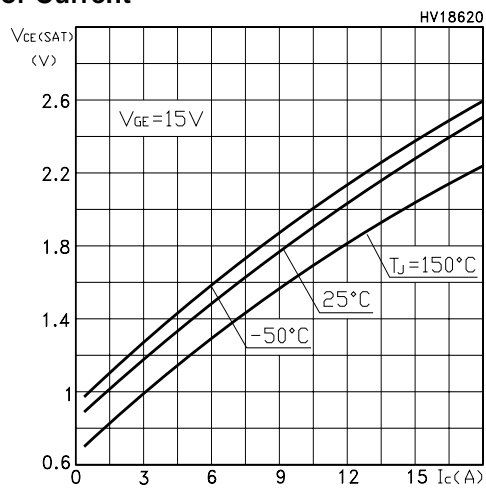


Figure 6: Transfer Characteristics

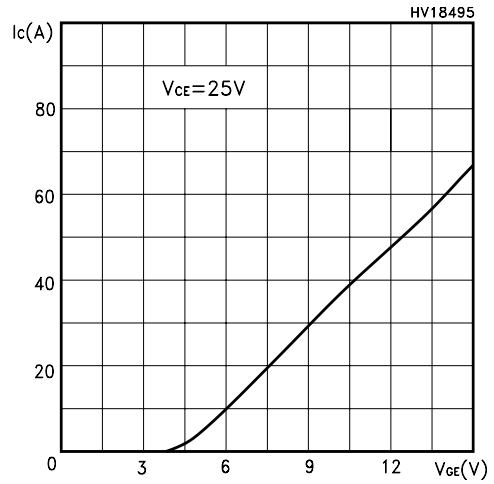


Figure 7: Collector-Emitter On Voltage vs Temperature

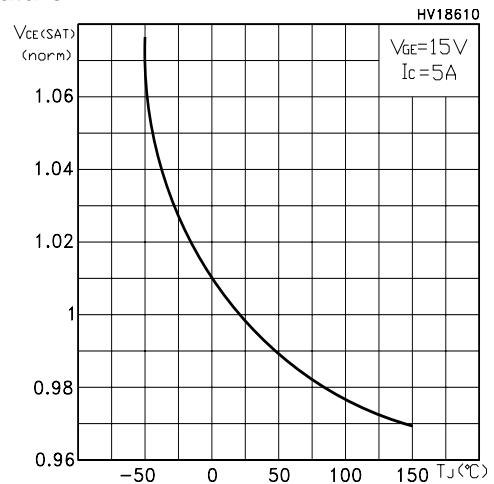


Figure 8: Normalized Gate Threshold vs Temperature

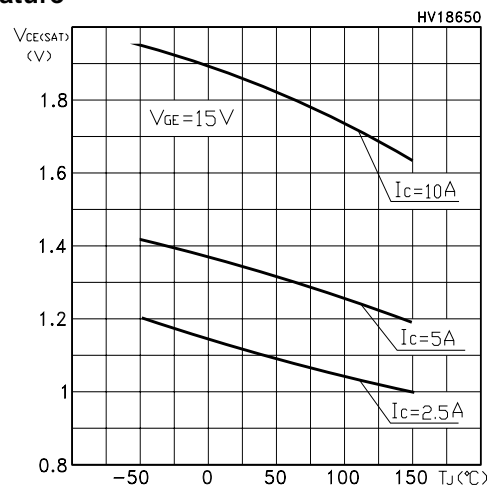


Figure 9: Gate Threshold vs Temperature

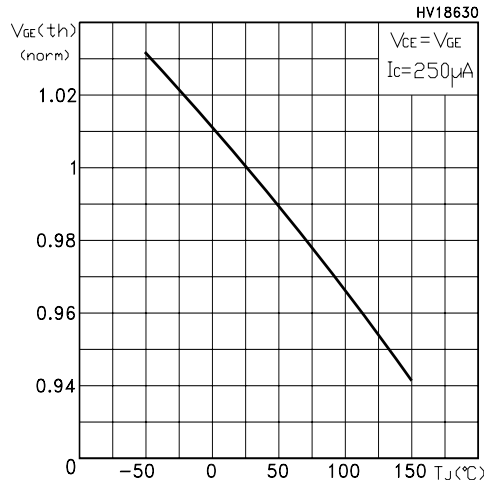


Figure 10: Capacitance Variations

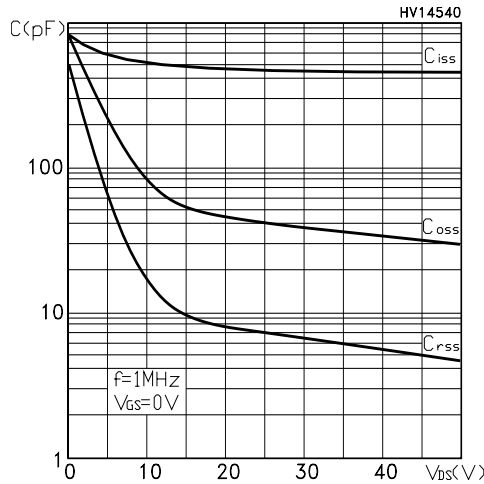


Figure 11: Switching Losses vs Gate Resistance

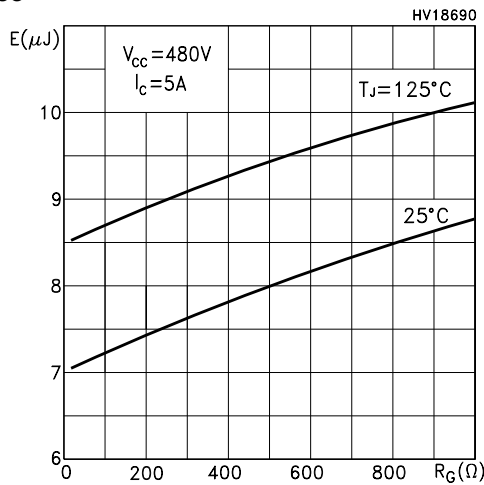


Figure 12: Breakdown Voltage vs Temperature

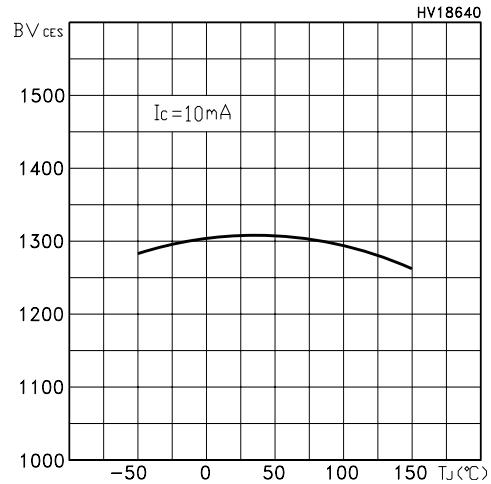


Figure 13: Gate-Charge vs Gate-Emitter Voltage

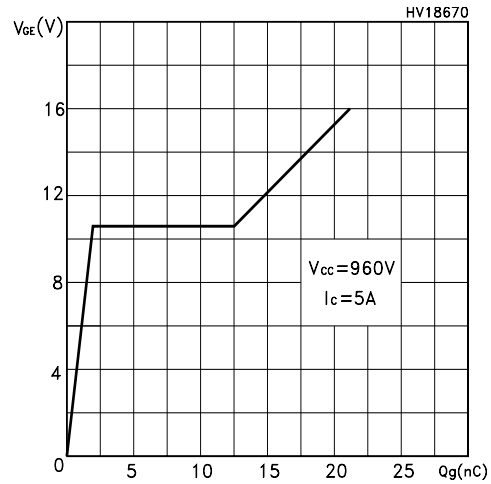


Figure 14: Switching Losses vs Collector Current

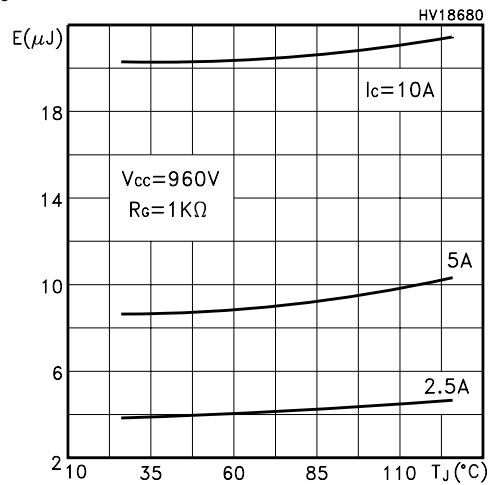


Figure 15: Thermal Impedance

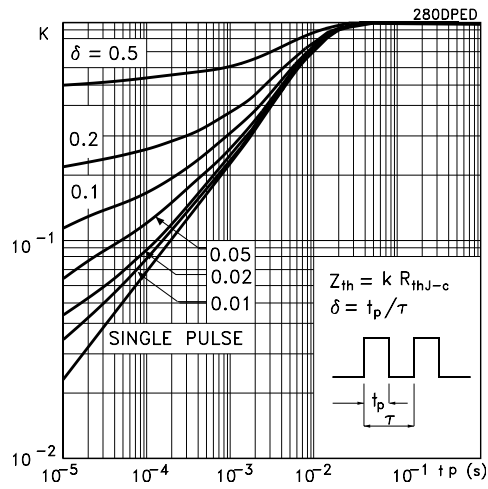


Figure 16: Turn-Off SOA

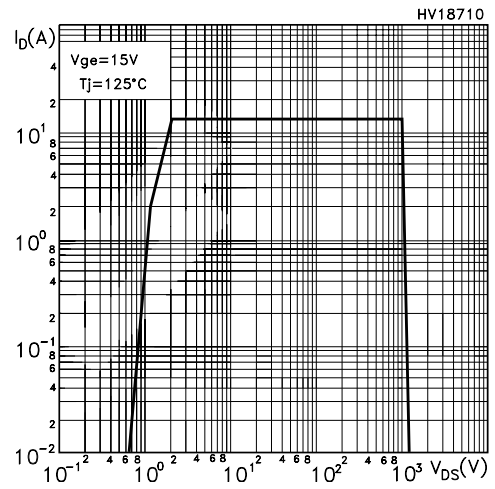


Figure 17: Test Circuit for Inductive Load Switching

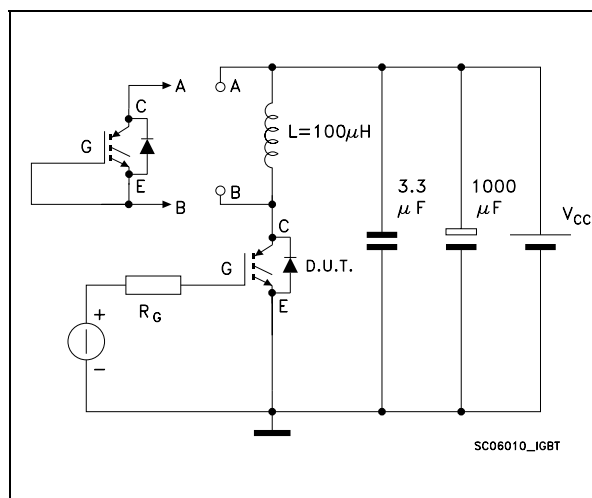


Figure 18: Switching Waveforms

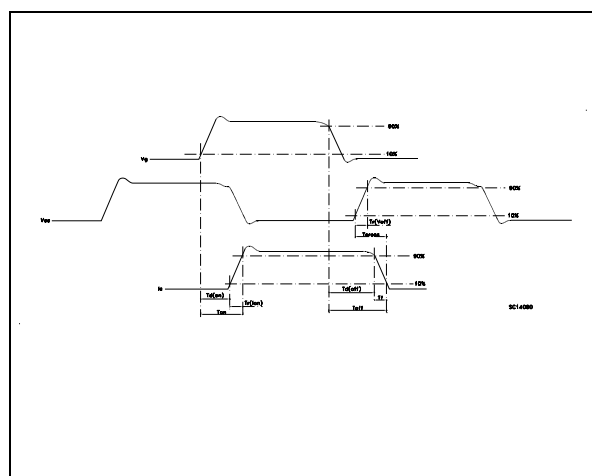


Figure 19: Gate Charge Test Circuit

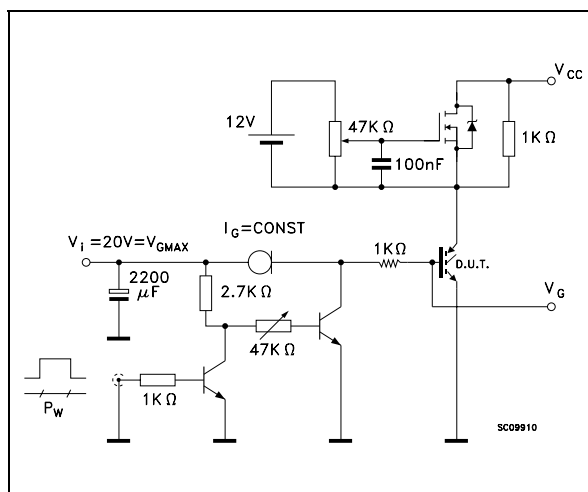
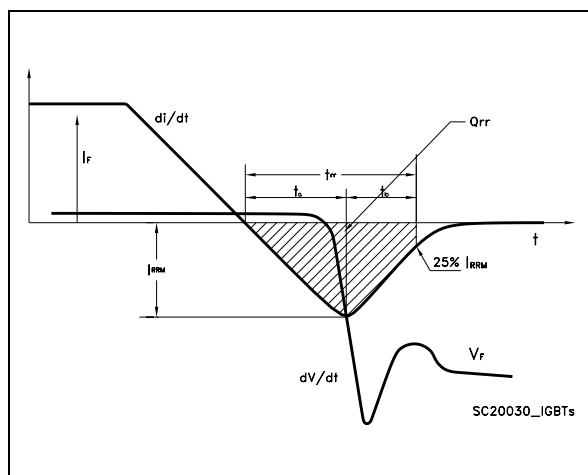
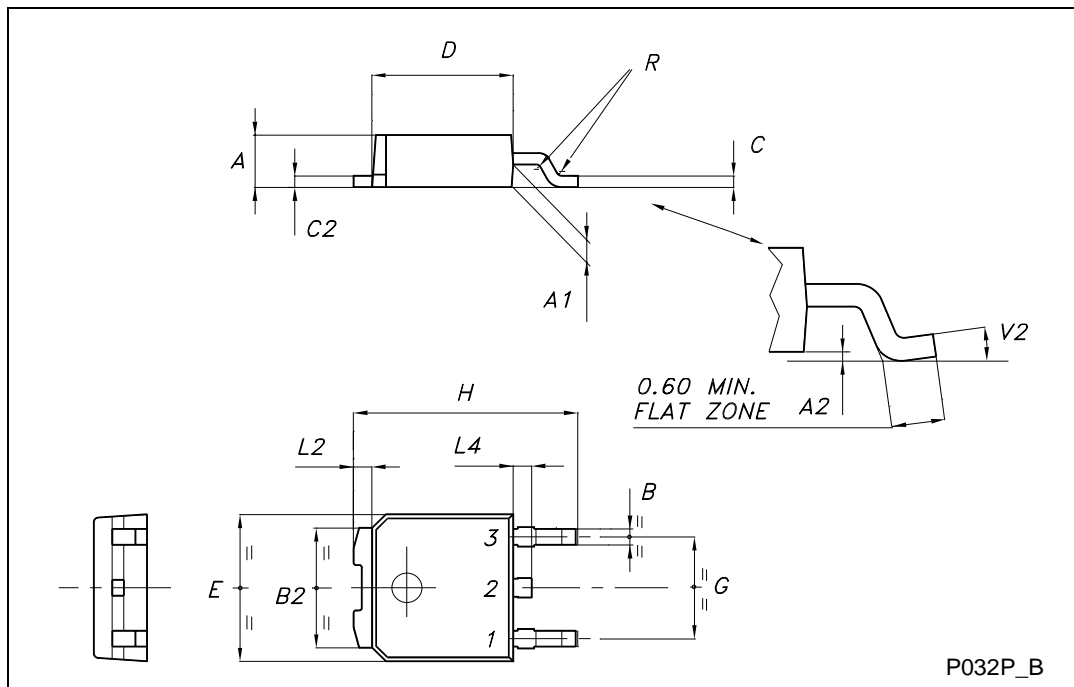


Figure 20: Diode Recovery Time Waveforms



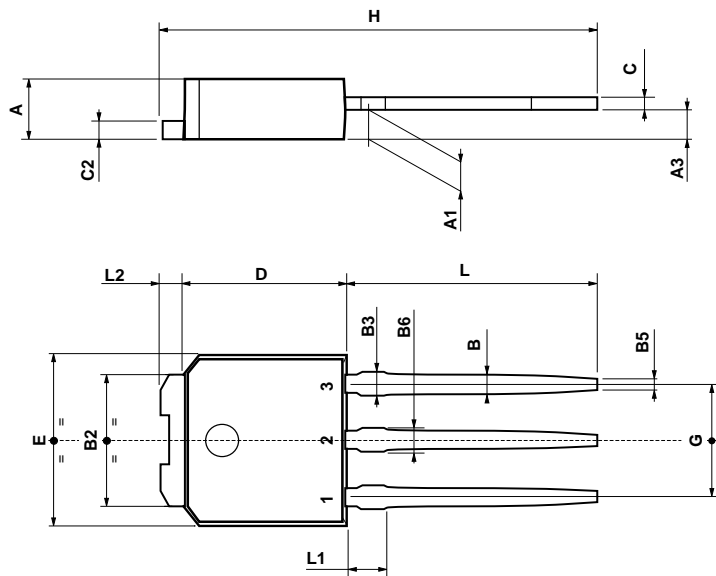
TO-252 (DPAK) MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.20		2.40	0.087		0.094
A1	0.90		1.10	0.035		0.043
A2	0.03		0.23	0.001		0.009
B	0.64		0.90	0.025		0.035
B2	5.20		5.40	0.204		0.213
C	0.45		0.60	0.018		0.024
C2	0.48		0.60	0.019		0.024
D	6.00		6.20	0.236		0.244
E	6.40		6.60	0.252		0.260
G	4.40		4.60	0.173		0.181
H	9.35		10.10	0.368		0.398
L2		0.8			0.031	
L4	0.60		1.00	0.024		0.039
V2	0°		8°	0°		0°



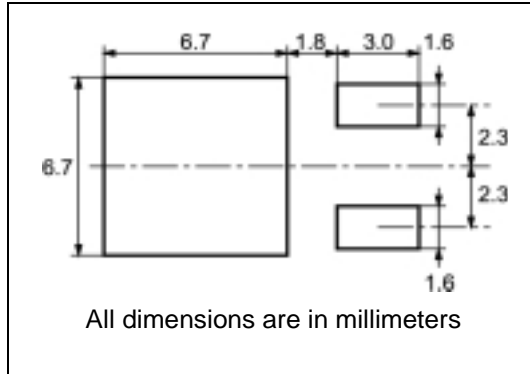
TO-251 (IPAK) MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A3	0.7		1.3	0.027		0.051
B	0.64		0.9	0.025		0.031
B2	5.2		5.4	0.204		0.212
B3			0.85			0.033
B5		0.3			0.012	
B6			0.95			0.037
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
E	6.4		6.6	0.252		0.260
G	4.4		4.6	0.173		0.181
H	15.9		16.3	0.626		0.641
L	9		9.4	0.354		0.370
L1	0.8		1.2	0.031		0.047
L2		0.8	1		0.031	0.039

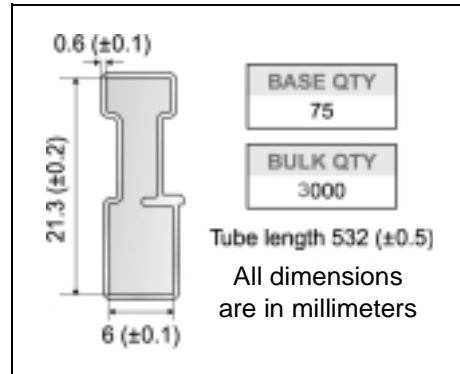


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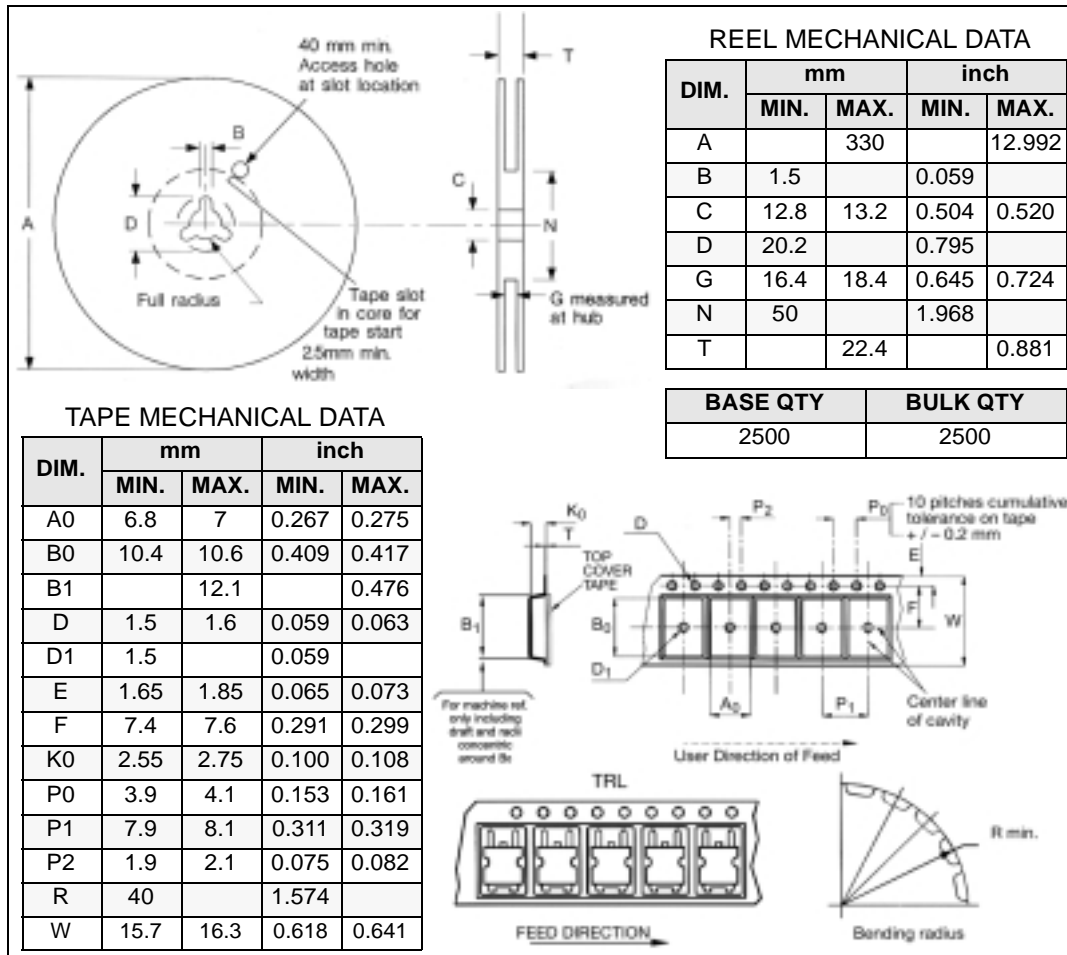
DPAK FOOTPRINT



TUBE SHIPMENT (no suffix)*



TAPE AND REEL SHIPMENT (suffix "T4")*



* on sales type

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Table 11: Revision History

Date	Revision	Description of Changes
06-Oct-2003	1	First release
18-Jan-2005	2	Final datasheet

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